Boiling Experiment Facility (BXF)

Glenn Research Center

Microheater Array Boiling Experiment (MABE) PI: Prof. Jungho Kim, University of Maryland
Nucleate Pool Boiling eXperiment (NPBX) PI: Prof. Vijay Dhir, University of California-LA
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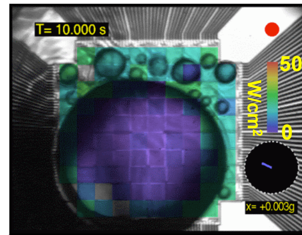
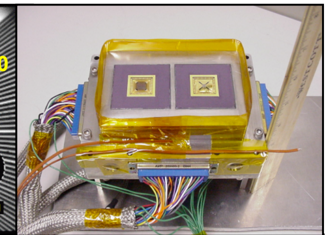
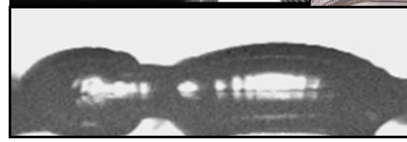
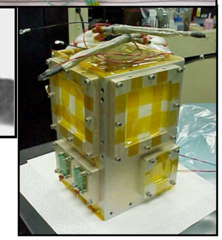
PM: William Sheredy, NASA GRC
Engineering Team: ZIN Technologies, Inc.



(Top left) Subcooled nucleate boiling in μg. The microheater array is colorized with actual heat flux data. (Top right) MABE heater assembly being prepared for calibration. (Bottom left) Coalescence of vapor bubbles on NPBX wafer. (Bottom right) BXF test chamber.

Objective:

- Determine the local boiling heat transfer mechanisms in microgravity for nucleate and transition boiling and critical heat flux.
- To understand bubble growth, detachment and subsequent motion of single and large merged bubbles.

Relevance/Impact:

- Enhance the development of two-phase thermal management systems, which provide isothermal control. By reducing the temperature difference between the heat source and radiator, the higher operating temperature for the radiator significantly reduces the area and weight of the radiator.
- Two phase thermal management systems rely on flow boiling to transport the heat from its source to its sink. Pool Boiling is an effective means of studying flow boiling.
  - Models to predict flow boiling heat transfer coefficients consist of pool boiling and liquid phase forced flow convection models.
  - The "No Flow" case is pool boiling in a confined area.

Development Approach:

- Two experiments, Microheater Array Boiling Experiment (MABE) and Nucleate Pool Boiling Experiment (NPBX) utilize the common BXF flight hardware/software system. The fluid used is normal-perfluorohexane.
- To achieve cost and schedule reduction, BXF was developed as Protoflight system; there is no engineering model. Minimum critical spares are available/purchased. Risk mitigation is by functional, environmental, and burn-in testing, plus additional verification methods.
- Carrier is ISS Microgravity Science Glovebox (MSG). Space Acceleration Measurement Systems (SAMS) triaxial sensor head in MSG will provide acceleration data to Principal Investigators.
- Autonomous operation with minimal ISS Crew time required for set up, video tape and hard drive exchanges, and equipment stowage.

ISS Resource Requirements

Accommodation (carrier)	Microgravity Science Glovebox
Upmass (kg) (w/o packing factor)	98.2
Volume (m³) (w/o packing factor)	0.144
Power (kw) (peak)	0.785 (includes MSG Power)
Crew Time (hrs) (installation/operations)	10
Autonomous Ops Time (hrs)	832: MABE 784; NPBX 48
Launch/Increment	19A/Increment 22-23

Project Life Cycle Schedule

Milestones	**SCR**	**RDR**	**PDR**	**CDR**	**Δ CDR**	**Safety**	**2ND CDR**	**VRR**	**FHA**	**Launch**	**Ops**	**Return**	**Final Report**
Actual/ Baseline	9/01	12/02	5/03	12/03	11/04	ΔPh.III-12/08	6-7/08	01/09	10/09	NET 2/10	Incr. 22-23	Ops +4 m	Return + 12m
Documentation	Website: http://spaceflightsystems.grc.nasa.gov/ Advanced/ISSResearch/MSG/BXF/ eRoom: (M) BXF - Boiling Experiment Facility					SRD: MABE Version 3.1; April 24, 03 NPBX Sixth Revision; January, 07 EDMP: **FY09 (planned for baseline)**				Project Plan: December 20, 07 SEMP: **GRC SEMP**			

Revision Date: 11/18/08